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May 13, 1983

SEL-7867

Headquarters
Warner Robins Air Logistics Center (AFLC)
Robins Air Force Base, GA 31098

Attention: WR-ALC/MMSRCA

Via: NAVPRO Office, Stratford, Connecticut

Subject: Model HH-53 Helicopter,
Durability and Damage Tolerance Assessment Report Submittal

Reference: (a) Contract FO 9603-81-G-1808, Delivery Order 0013

Enclosures: (1) HH-53C DTA Current Program Schedule
(2) HH-53C DTA Steering Committee Agenda; March 29-30
(3) HH-53C DTA Criteria for Screening Critical Areas

In accordance with DD 1423 Sequence A001 of the subject contract, the contractor herewith submits the monthly status letter.

Progress continued this month on the NASTRAN model of the forward cabin (see Enclosure (1)). Some program slippage was experienced in both the mass distribution and updating cabin stiffness. The transmission and sponson geometry definition was reassigned to the CAD group and new commitments from the weights group were obtained. The program should be back on schedule by April 15. Screening of sensitive dynamic components has also been started. Overall expenditures are about 18% of budget at this point. Although light, the charges are expected to rise as the NASTRAN model of the aft fuselage is generated. This will have to be a complete new model unlike the forward cabin which is a modified CH-53E model.

The steering committee meeting also occurred on March 29-30. The agenda is shown in Enclosure (2). Conclusions reached are as summarized:

Progress: Satisfactory

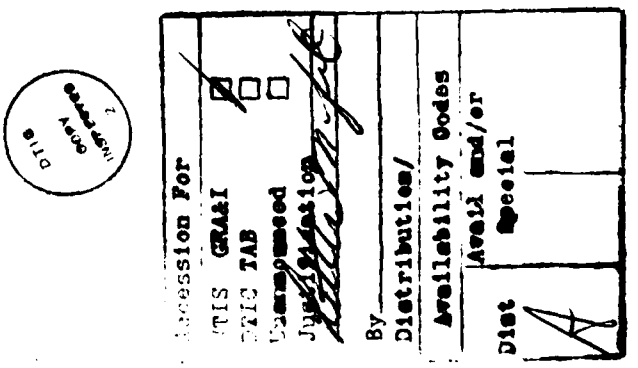
Nastran Model: The four CG/GW configurations may not be sufficiently versatile to handle the variety of GW/CG combinations that are anticipated for damage tolerance analyses. An alternate approach was suggested and will be investigated for feasibility.

The approach will use an empty gross weight configuration NASTRAN model which Warner Robins analysts can "load" with cargo and other fixed weight items connected to standard tiedown points by RBE-3 elements. This would require recalculation of rotor head loads to maintain a balanced system. The accuracy of this approach would be further checked by the use of three other NASTRAN models at alternate gross weights (i.e., 50,000# internal and external loading and 650 gal. aux tanks - 327 and 358.5 in.CG and 33,500# at 362 in.CG). It is hoped that if the approach correlates well with the models, the 50,000# all internal cargo case can be achieved at no additional cost.

Selection Criteria for Dynamic Components: It was agreed that even if a part does not appear to be manageable by damage tolerance analysis, appropriate action should be taken to increase confidence in the structural integrity of the part. This might include one-time inspections, simple rework or other appropriate action.

Fracture Mechanics Sensitivity Screening: Two sample problems were reviewed and basic screening criteria proposed. These are shown in Enclosure (3). It was further noted that for parts having a uniform high stress field, critical origins at handling damage sites should be considered. In all cases, engineering judgement should be used to assess the general sensitivity of the part. Part disposition will be a subject of steering committee review.

Loads Input: It was noted that loads used in exercising the NASTRAN model for design purposes are related to maneuvers not appropriate to a damage tolerance analysis (i.e., symmetric dive and pullout vs. high speed cruise). The models will be exercised to establish their proper function using severe maneuver conditions. It was agreed to investigate the costs involved in running sufficient basic steady state conditions (hover,climb, cruise, etc.) and maneuver conditions (reversals, turns, etc.) to establish regression formulas for determining applied rotor loads as a function of GW and CG. It is estimated that five steady state and 15 transients will be required per GW/CG combination.



Load History Similation: The Monte Carlo simulator program developed under Ground Test IR & D was reviewed. With minor modifications, it will serve quite well for DTA work. Simplified flow charts on overall DTA software requirements should be available for the next steering committee meeting. Usage monitoring and parts trading issues were put off for future discussion when specifics about dynamic components are available.

Very truly yours,

UNITED TECHNOLOGIES CORPORATION

Anthony S. Canaverde
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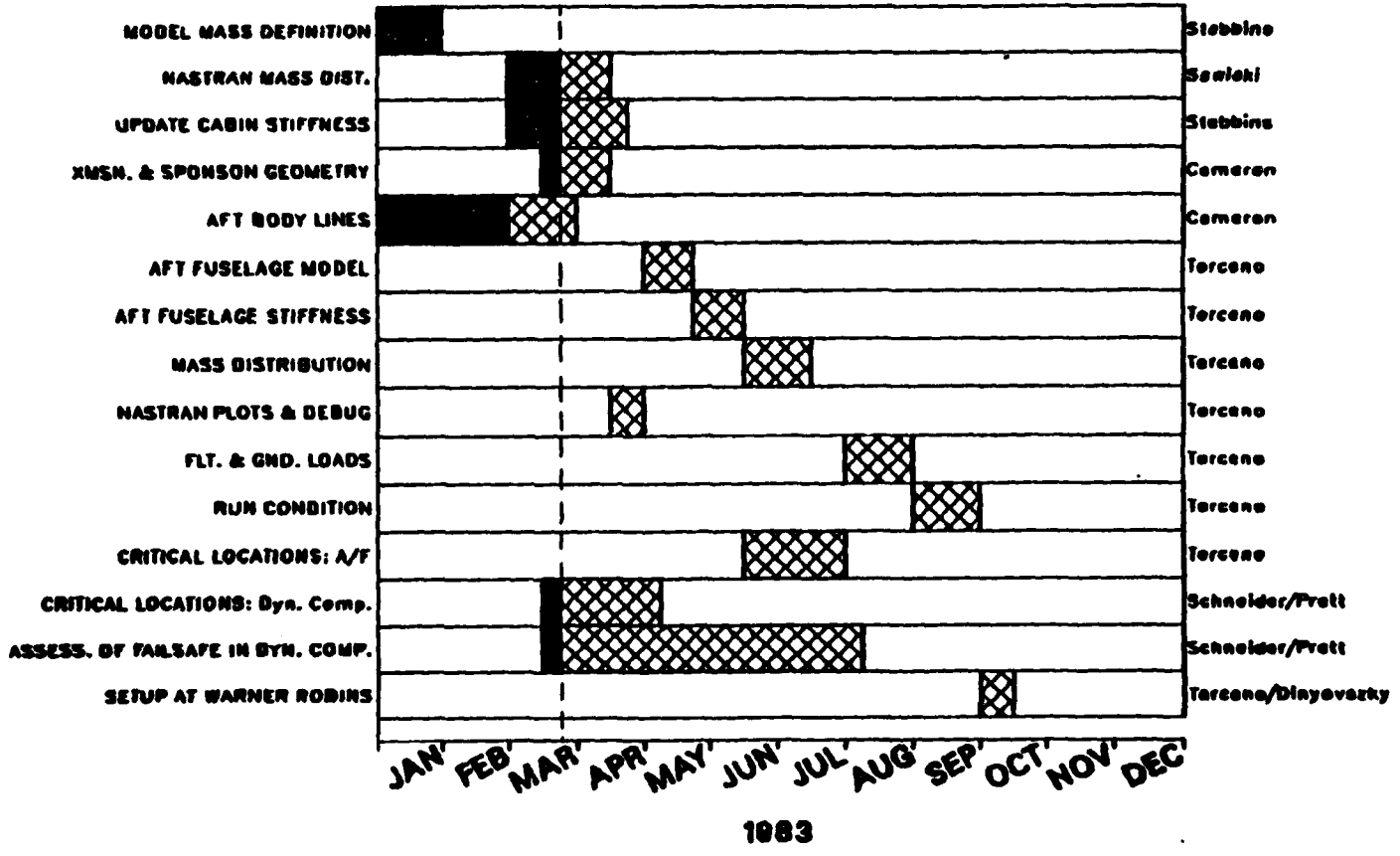
P.E. STERLING
By direction

cc: WR-ALC/MMSRD (Lewis)(2)
WR-ALC/MMSRC (Hilliard)(1)
WR-ALC/MMEAV (1)
DDC (2)
ASD/ENFS (Dr. Lincoln)
ASD/ENFS (Davidson)

HH-53C D.T.A. SCHEDULE



SEL-7867
Enclosure (1)

SEL-7867
Enclosure (2)

HH-53C DTA Steering Committee Agenda: March 29-30

SUBJECT	PRESENTOR
• Overview/Schedule Budget	Pratt
• NASTRAN Model Review	Stebbins
• Geometry Matrix Generation and Computer Aided Design	Cameron
• MSC NASTRAN: Estimated Run Times on WR VAX 11/780	Dinyovszky
• Selection Criteria for Dynamic Components	Pratt
• Sensitivity Analysis and Critical Origins	Spencer
• Fracture Mechanics Sensitivity Screening (with examples)	Schneider
• Open Discussion	ALL
- input loads	
- MonteCarlo load history simulation	
- parts tracking	
- usage monitoring	

HH-53C DTA

Criteria for Screening Critical Areas

Assume:

ΔK_{Thresh} = 2 KSI $\sqrt{in}$ (Al)
= 4 " (Ti)
= 6 " (Fe)

a_{det} = .030" x .060" Surface flaw
= .030 corner flaw

Compute

1. a_{thresh} (base on vibratory stresses)

2. a_{crit}

3a. If $a_{thresh} > a_{det}$ estimate low cycle fatigue (LCF) time to a_{det}

3b. If LCF time > 2 life times no further analysis req'd.

4. If LCF time < 2 lifetimes a detailed analysis is req'd.

5. If $a_{thresh} < a_{det}$ make preliminary crack growth/hr. calculation and place on a list for a steering group review.